

Research Article

Dare to Experiment: The Synergistic Relationship Between Undergraduate Research and Experimental Economics

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Abstract

Little attention has been given to the synergistic relationship that can exist between experimental economics research and undergraduate research experiences. In this article, we highlight the successes and challenges from working with more than 70 undergraduate research assistants at the University of Delaware's Center for Experimental and Applied Economics (CEAE) since 2007. We describe our approaches for funding and engaging undergraduate students and efforts, including our layered mentorship network, to support CEAE's mission to cultivate a diverse and inclusive research community. We present the results of a survey of CEAE's alumni to understand how their research experiences influenced their undergraduate education and their post-graduate educational and career endeavors. Synthesizing the reflections of students and the experiences of lead researchers, we outline ten key recommendations regarding how faculty and administrators in agricultural and applied economics programs can design and implement successful undergraduate research experiences, strengthening the pipeline of researchers in our field.

1 Introduction

The value of using economic experiments in the classroom has been acknowledged for decades in agricultural and applied economics (Barnett and Kriesel 2003), and in economics more broadly (Hoyt and McGoldrick 2019). However, little attention has been given to the myriad opportunities that exist for unique undergraduate research experiences in experimental economics labs. At the University of Delaware's Center for Experimental and Applied Economics (CEAE), we have found that engaging undergraduate students in experimental economics research studies outside of the classroom can produce win-win opportunities for students and researchers. Students gain experiential learning opportunities and often receive financial compensation, while researchers gain support for conducting experiments and benefit from fresh ideas, perspectives, and questions. CEAE has supported more than 70 undergraduate research assistants in the past sixteen years. In sharing the process that we have followed to foster undergraduate research, we aim to contribute ideas to a growing conversation about how to facilitate meaningful research experiences for undergraduate students in agricultural and applied economics.

Economic experiments offer many opportunities for student engagement in undergraduate research, including engaging students early in their undergraduate programs and for students from other disciplines. In other subfields of economics, opportunities for undergraduate research assistants may be more limited. In part, this is because researchers often struggle to find synergies between the knowledge and skills required to conduct research and the potential contributions of undergraduate students with limited training (Hoyt and McGoldrick 2017). In contrast, even students with little economics training can directly support certain aspects of developing an economic experiment (e.g.,

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programming and pre-testing) and collecting data. Students can also learn data analysis skills, learn about research administration and accounting in an academic setting, and/or gain experience communicating experimental results. Students develop more knowledge and skills over time and can handle increasingly complex research tasks. Additionally, having a cohort of undergraduate students all working on experimental projects allows for economies of scale in terms of mentoring and managing a team of research assistants (Hoyt and McGoldrick 2017). Experiments offer a unique platform for students to simultaneously be “learning economics” and “doing economics,” much like community engagement projects have been used in other contexts (as described by Henderson 2016).

The goal of this paper is to highlight the opportunities, successes, and challenges in engaging undergraduate students in experimental economics research, and to provide insights and recommendations for researchers in agricultural and applied economics who are interested in developing undergraduate research experiences. To accomplish this goal, we surveyed past undergraduate research assistants to learn about the value of their experiences engaging in experimental economics research (e.g., conducting literature reviews, developing experimental programs, implementing lab and field experiments, and even co-authoring peer-reviewed publications). We also asked them to describe how their undergraduate research experience influenced their undergraduate education and the next steps in their professional lives. As a follow up to the survey, we conducted in-depth interviews with four former students to gain a deeper understanding of the findings from the survey and students’ experiences with CEAE.

The vast majority (32 students, about 91 percent) of survey respondents were satisfied with their undergraduate research experience, and no respondents indicated any level of dissatisfaction (the other three students answered “neither satisfied nor dissatisfied”). The overall satisfaction came from how respondents felt about their work, the support they received, and the benefits they obtained. The majority of respondents (31 students, about 89 percent) felt their work was meaningful and that their thoughts and insights were valued by people working with them on the research. All respondents gained a better understanding of research, and the majority of respondents reported improved research skills such as explaining scientific concepts related to their work (27 students, about 77 percent) and summarizing scientific results/impacts (26 students, about 74 percent). Although most respondents’ tasks were related to research projects, the research experience also improved respondents’ professional abilities and skills. Respondents indicated that they improved their decision-making skills (33 students, about 94 percent), ability to work independently to problem-solve (32 students, about 91 percent), and knowledge of professional workplace expectations (32 students, about 91 percent). Working with CEAE also affected respondents’ post-undergraduate life paths by increasing their interest in pursuing a career in applied economics. For instance, the CEAE experience prompted several talented students to remain at our university or join another program to pursue a graduate degree.

Based on our experiences as lead researchers and the results of the survey and interviews, we discuss the advantages and challenges of working with undergraduate research assistants, and we offer ten recommendations for faculty and administrators who seek to enhance undergraduate research by connecting them to experimental economics studies. These recommendations are reflective of CEAE’s commitment to making research accessible to undergraduate students from diverse backgrounds with varying levels of economics knowledge and training. We also emphasize the value of engaging undergraduate students in their first or second year of study—the marginal net benefit of engaging undergraduates early in their program is higher than many assume and contributes to economies of scale and scope (Wagner 2015). Undergraduate research experiences increase students’ interest in pursuing further education and careers in STEM fields; therefore, this approach is also designed to strengthen the pipeline of agricultural and applied economists.

2 Background

2.1 Background of UD's Center for Experimental and Applied Economics

Founded in 2007 as an experimental economics laboratory and formally named by the University of Delaware (UD) as an official “center” in 2014, the CEAE is based in the Department of Applied Economics and Statistics within the College of Agriculture and Natural Resources. The center has benefitted from investments from both the department and college in terms of space (the lab is approximately 2,000 sq. ft. and includes office space, a kitchen, and storage), equipment (computers, stationary and mobile lab facilities, and eye-tracking software), and staff (lab coordinator and research manager). Additionally, a large source of financial support for CEAE infrastructure and CEAE-supported research has been provided through external grants, such as those from the United States Department of Agriculture (USDA) and the National Science Foundation (NSF).

First and foremost, CEAE is an active and growing research community. The community is comprised of faculty, staff, postdoctoral researchers, graduate students, undergraduate students, and occasionally high school students who contribute to applied economics research studies. The CEAE leadership team includes the director, two staff members, and postdoctoral researchers, and the center is guided by an advisory council. CEAE’s mission is “*to nurture a diverse and inclusive community engaged in innovative, evidence-based research and dissemination of results to inform policy and promote sustainability at the nexus of agriculture and the environment.*” CEAE fulfills this mission by training and mentoring students and early career scholars and by facilitating innovative experimental and applied economics studies. When we use the phrase “CEAE research,” we are referring to research that has been supported by CEAE resources, which includes studies led by many affiliated researchers over the past sixteen years. Affiliated researchers include faculty, postdoctoral researchers, and students in the Department of Applied Economics and Statistics and other academic units across the UD campus. CEAE has also supported affiliated researchers beyond UD through the support of multi-institution-sponsored research projects.

Most of the research supported by CEAE uses laboratory and field experiments to study economic behavior impacting agriculture, the environment, natural resources, and rural/urban communities. This research informs the design of improved policies, markets, and products that benefit individuals and society. Affiliated researchers have conducted more than 130 studies, which have included more than 60,000 participants. Almost all of these studies have involved working with undergraduate students in various capacities, such as collecting data, reconciling expenses, and/or communicating the results via social media or other means. More than 100 faculty and PhD researchers at UD and researchers at more than 30 institutions have collaborated in research facilitated by CEAE. To date, these studies have resulted in more than 110 papers in peer-reviewed journals and have informed a chapter on experimental and behavioral economics for the *Handbook of Agricultural Economics* (Palm-Forster and Messer 2021) and a commissioned report for the National Academy of Sciences summarizing the application of behavioral economics to climate change policy (Messer, Ganguly, and Xie 2023). Affiliated researchers have also been active in professional meetings and have presented their research more than 450 times.

CEAE research has been repeatedly recognized by external funding agencies, such as USDA, NSF, National Oceanic and Atmospheric Administration, and U.S. Environmental Protection Agency. To date, the CEAE leadership has been a Principal Investigator or co-Principal Investigator on 77 grants worth more than \$77 million, including Delaware’s \$23 million NSF-EPSCoR Track-1 project entitled, “Water in the Changing Coastal Environment of Delaware” (aka Project WiCCED) that started in 2018. Since 2014, CEAE has served as the co-headquarters of the USDA-funded Center for Behavioral and Experimental Agri-Environmental Research (CBEAR), which has twice been named a USDA Center of Excellence. In most of these grants, funds are budgeted specifically to hire undergraduate research assistants. We have

also found that having large, ongoing research projects has enabled us to readily tap into our university's internal internship programs such as those offered by the Delaware Environmental Institute (DENIN) and the Delaware Water Resources Center. The success rate for undergraduate students that we have sponsored to receive these internal sources is approximately 80 percent.

A layered mentorship program, called the CEAE Mentoring Network, supports our mission to cultivate an inclusive academic community of applied economics researchers. Since its launch in 2019, this program has evolved to emphasize layered and peer mentorship rather than one-to-one mentor-mentee pairs. Undergraduate and graduate students are assigned to mentorship groups, led by postdoctoral researchers. Within the groups, students are both mentees and mentors and engage in peer-to-peer mentorship. Participants are given some general guidance for engaging in the program, but groups are given the autonomy to structure their activities and interactions in a way that best supports the goals of the group. This independence was particularly important in 2020 and 2021 when many people were working remotely due to the COVID-19 pandemic and subsequently started transitioning back to campus. There are about 15–20 participants in the mentorship network each semester.

One way that we uphold CEAE's mission *to nurture a diverse and inclusive community* is through our approach to engaging and training undergraduate students as research assistants. Undergraduate research assistants have served in numerous roles within CEAE. Working collaboratively with graduate students, postdoctoral researchers, staff, and faculty, undergraduates have assisted with experiment programming, data collection, communications, and administrative support. The experiences of undergraduate research assistants can differ substantially depending on project timelines and student interests. Research assistants may support multiple aspects of the research process from experimental design through the communication of results. Some students lead undergraduate thesis projects, while others have more narrow roles in projects led by other researchers.

2.2 Pathways for Undergraduate Research

CEAE has established multiple pathways for undergraduates to engage with research. Students can begin working as research assistants via (a) our volunteer program, (b) academic-year or summer internship programs supported by units on-campus or via externally funded projects, (c) paid hourly positions, and/or (d) undergraduate thesis courses.

The CEAE volunteer program (aka the "CEAE talent pool") has provided a low-stakes entry point for students who are curious about research, but unsure if they want to commit to an internship or longer-term position. Volunteer positions also provide an opportunity for CEAE leadership to learn about the students, observe their work ethic and level of commitment to their role, and determine if they are a good fit for a paid position.

Internship positions have been a fruitful way to identify students with research interests across the university and beyond. We actively seek opportunities to partner with other units on campus to engage undergraduate interns with combined support from the university and from externally funded projects (as described above). We have also engaged with external programs that recruit students from other universities, including historically Black colleges and universities. These programs have added to the diversity of our undergraduate team and provided opportunities to learn from different perspectives. Additionally, because these internship positions are typically funded through programs outside of CEAE, they offer a mechanism to hire additional undergraduate research assistants without the need to raise additional CEAE funds.

Paid hourly positions offer a flexible option for hiring research assistants to perform various research support tasks. Generally, we have sought to pay interns approximately 20 percent higher than the prevailing wage on campus. Many of our paid hourly students started as volunteers, interns, or teaching assistants. Hourly positions allow us to retain outstanding students. As a student gains more experience in CEAE, their hourly rate increases (typically by semester).

Depending on the path through which a student is working with CEAE, they will have opportunities for training, mentorship, and professional development. Much of this training occurs through their experiences as an undergraduate research assistant as they learn on the job. Additionally, all students are invited to participate in the CEAE Mentoring Network. Students are also encouraged to gain experience communicating their research through poster sessions and research communication competitions (e.g., DENIN's Pitch90 competition²). Students supported by internship programs are typically invited to engage in a professional development series, which includes focused sessions on topics such as opportunities for graduate school. These students are also invited to present posters and/or talks in undergraduate research symposia that are held each semester and at the end of the summer.

3 Survey and Interviews of CEAE Undergraduate Research Assistants

3.1 Survey

To better understand undergraduate students' experiences working with CEAE, we developed a qualitative survey that collected information about students' backgrounds (e.g., major, undergraduate enrollment dates, and demographics), their responsibilities within CEAE, satisfaction and benefits gained from working with CEAE, life paths after graduation, and opinions on mentoring and diversity in CEAE. The survey consisted of 30 questions and took about 15 minutes to complete.

The survey was available on Qualtrics from June 28 to July 31, 2023. CEAE staff maintain a database of all previous undergraduate research assistants. Initial invitations were sent out to all 73 former students via emails and personal LinkedIn messages on June 28, and one reminder was sent out on July 12. After the survey was closed on July 31, we randomly selected five respondents who completed the survey and opted into the raffle to receive a \$50 Amazon e-gift card (students were informed about this incentive in the invitation).

3.2 Interviews

In addition to the survey, four one-on-one, approximately 30-minute interviews were conducted with former undergraduate researchers in CEAE to help us gain a deeper understanding of the survey findings. All interviewees were paid \$50 for their participation. The interview questions explored how and why the student got involved with CEAE, the benefits and challenges they faced during their time with CEAE, if working with CEAE influenced their perspective on applied economics and research, and if their experience impacted their post-undergraduate program life path.

Interviewees were selected in a manner that ensured a diversity of perspectives was represented. All four of the primary paths undergraduate students follow to work with CEAE were represented (teaching assistants recruited for paid hourly positions, summer interns, students completing an undergraduate thesis, and applicants to the CEAE talent pool). Both UD and non-UD students were represented, as were both economic and non-economic majors. A variety of skill sets were also represented, ranging from computer programmers to data collectors to designers of experiments.

4 Results

4.1 Survey

A total of 35 students completed the survey, resulting in a 48 percent response rate. The years respondents were enrolled in their undergraduate programs ranged from 2010 to 2023. The majority of the respondents (32 students, about 91 percent) studied at UD for their undergraduate program. The

² <https://www.denin.udel.edu/pitch90/>

other three students (about 9 percent) were enrolled at another undergraduate institution during their time as a CEAE research assistant. About half of the respondents studied an economics-related major (i.e., agricultural and natural resource economics, economics, environmental economics, or environmental and resource economics). The other half of the respondents studied non-economics majors (e.g., accounting, biological science, and gender and women’s studies). Nineteen respondents (about 54 percent) identified as female, and the remaining 16 respondents (about 46 percent) identified as male. A majority (24 students, about 69 percent) of respondents identified as white or Caucasian. Only one respondent was an international student. This is similar to the general enrollment profile within UD’s College of Agriculture: as of 2022 Fall, 70 percent of undergraduates were female, about 71 percent were white, and 3.1 percent were international students.³

The most common responsibility of the respondents was data collection, with 29 students (about 83 percent) reporting they collected experimental data at some point during their time with CEAE (Figure 1). Respondents were commonly tasked with multiple responsibilities, with 27 students (about 77 percent) indicating that they had at least two responsibilities. Data collection (i.e. collecting experimental data) was commonly combined with two other tasks for students: experimental design and/or collecting background information (e.g., reviewing relevant literature and collecting news articles). In particular, 19 students (about 54 percent) collected background information in addition to collecting data, 13 students (about 37 percent) assisted in experiment design in addition to data collection, and 11 students (about 31 percent) engaged in all three tasks. Combining responsibilities helps research assistants better understand their research projects and communicate with research participants during data collection.

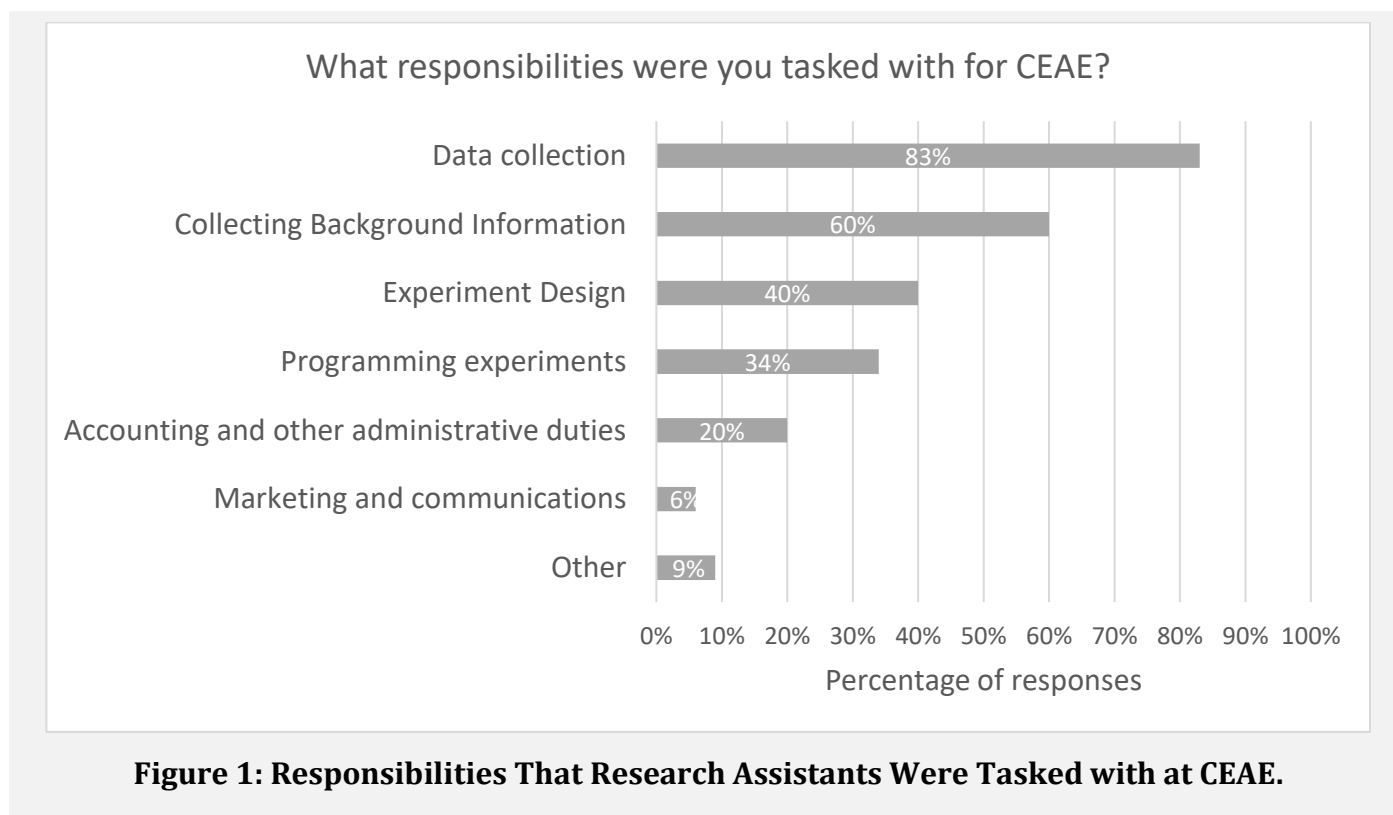


Figure 1: Responsibilities That Research Assistants Were Tasked with at CEAE.

³ Source: <https://ire.udel.edu/ir/diversity/>.
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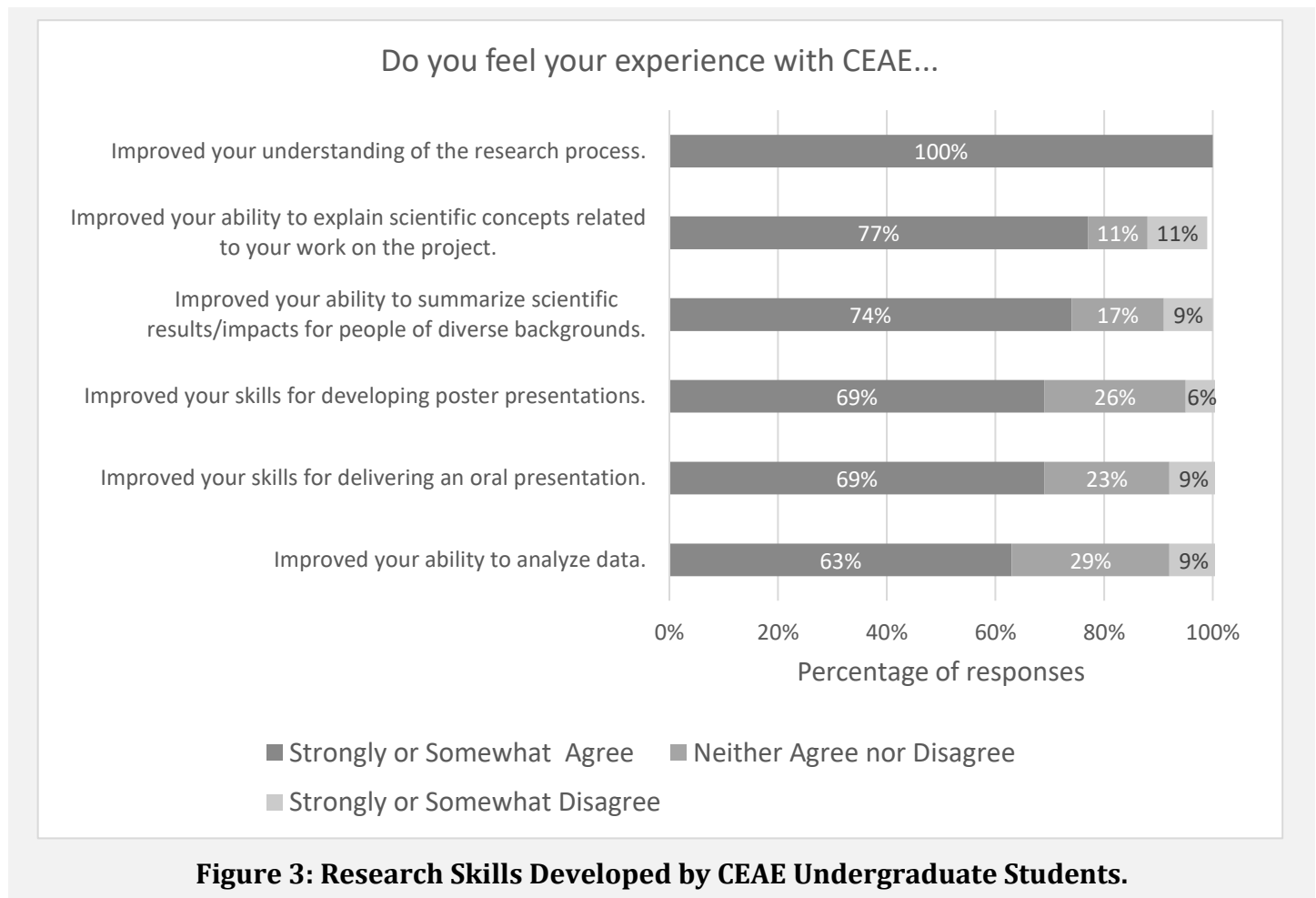
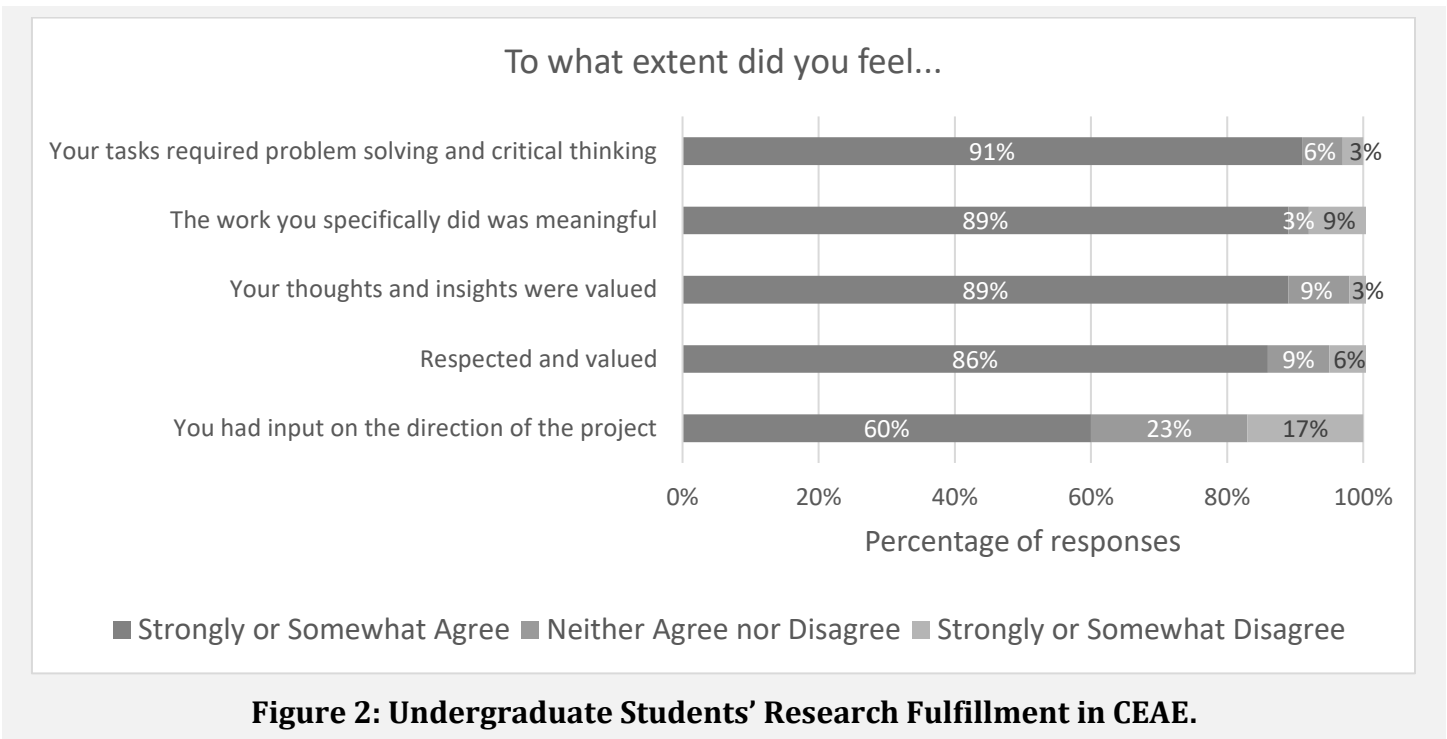
The majority (30 students, about 86 percent) of the respondents were paid for their work at CEAE at some point, and of the 30 respondents who were paid, most (28 students, about 93 percent) were either somewhat or extremely satisfied with the compensation they received. This is consistent with our philosophy of trying to attract exceptional students and retain them as we consistently sought to pay hourly wages that exceeded other jobs on campus by approximately 20 percent. Among the remaining five respondents who were not paid, one respondent received course credits and the other four were volunteers. In addition, many respondents worked on a team with other undergraduates and talked to other undergraduates working for CEAE. Some research assistants (18 students, about 51 percent) also helped recruit and train new undergraduate research assistants.

A major focus of the survey was to understand undergraduate research assistants' satisfaction and perceived benefits from working with CEAE. The vast majority (32 students, about 91 percent) of the respondents were satisfied with their experience in CEAE, and no respondents indicated any level of dissatisfaction. Twenty-one students (about 60 percent) were extremely satisfied with their experience, and 11 students (about 31 percent) were somewhat satisfied. The other three students (about 9 percent) reported being neither satisfied nor dissatisfied. Most respondents thought that the project(s) they contributed to would advance the field of applied economics (27 students, about 77 percent) and have real-world impacts on practices and policies (29 students, about 83 percent).

Overall satisfaction with their undergraduate research experience may come from how respondents felt about their work, the support they received, and the benefits they obtained. As shown in Figure 2, the majority of respondents agreed that the work they specifically did was meaningful (31 students, about 89 percent), their thoughts and insights were valued (31 students, about 89 percent), they were respected and valued (30 students, about 86 percent), and their tasks required problem-solving and critical thinking (32 students, about 91 percent). Fewer (21 students, about 60 percent) respondents agreed that they had input on the direction of the project. This is not surprising because undergraduate researchers support the Principal Investigators for projects, who are typically faculty, postdoctoral researchers, and graduate students. Respondents indicated that they received effective support from CEAE leadership (directors, postdocs, and staff) and affiliated researchers in balancing their research assignments with their class work, physical and mental health, and social life.

Working with CEAE provides undergraduate research assistants with opportunities to have a better understanding of research and gain research skills (Figure 3). Research experience with CEAE improved all respondents' understanding of the research process. This can be partially attributed to the fact that most respondents (27 students, about 77 percent) were tasked with multiple responsibilities throughout the research process and engaging in multiple stages of research projects. The majority of respondents improved their ability to explain scientific concepts related to their work (27 students, about 77 percent) and summarize scientific results/impacts (26 students, about 74 percent). As undergraduate research assistants in CEAE usually work in a research team, they learn how to explain scientific concepts and summarize scientific results from discussions with their team members. Twenty-four students (about 69 percent) improved their skills in delivering an oral presentation or developing poster presentations. Undergraduate research assistants who were funded through internships usually delivered a poster or oral presentation at the end of their internships—this provided them with opportunities to learn and improve presentation skills. However, not all undergraduates (particularly those with limited hours and responsibilities) have opportunities to present research in poster or oral presentation formats.

Compared to understanding, abilities, and skills related to research, respondents' professional abilities and skills experienced even more growth (Figure 4), along with their collaborative skills (Figure 5). The majority of respondents agreed that their research experience with CEAE improved their decision-making skills (33 students, about 94 percent), ability to work independently to problem-solve (32 students, about 91 percent), knowledge of professional workplace expectations (32 students, about



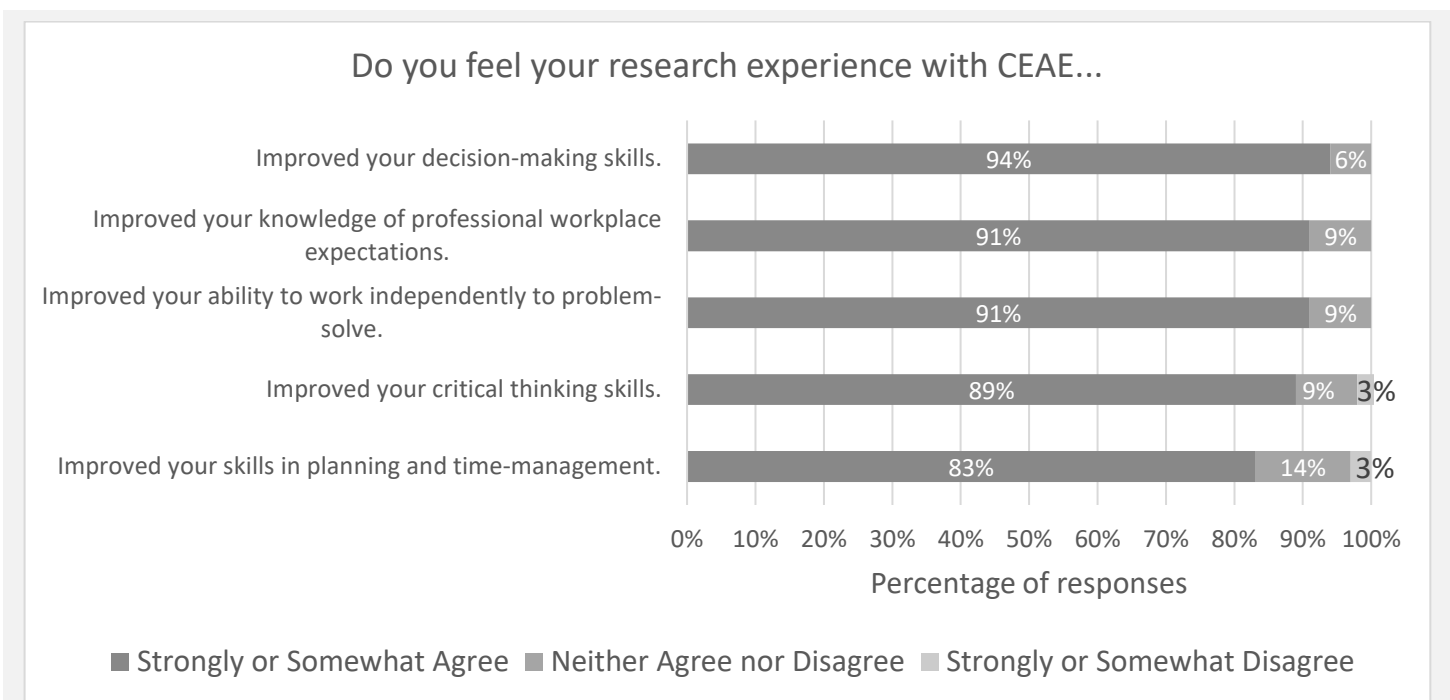


Figure 4: Professional Skills Developed by CEAE Undergraduate Students.

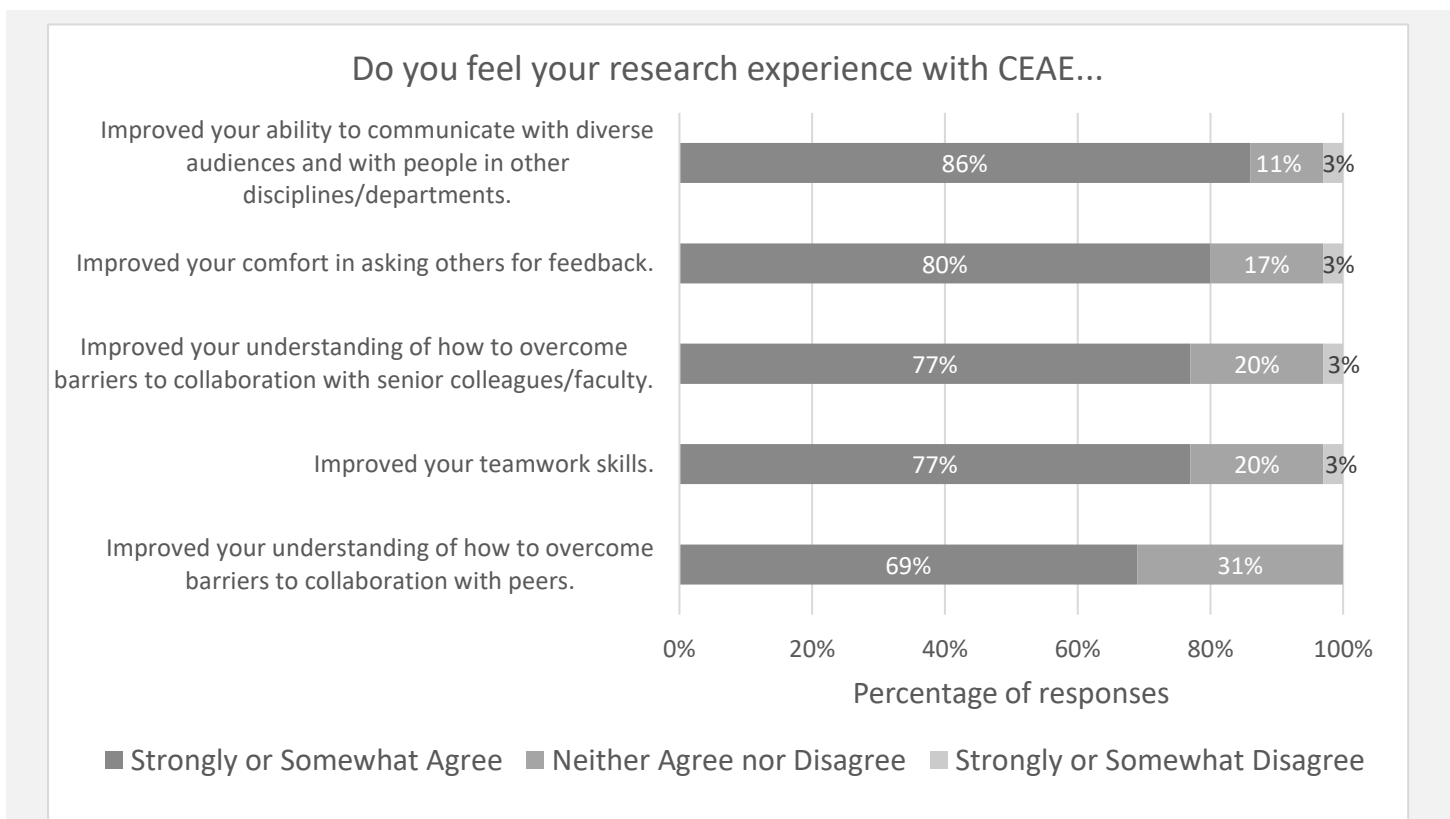


Figure 5: Collaborative Skills Developed by CEAE Undergraduate Students.

91 percent), critical thinking skills (31 students, about 89 percent), as well as planning and time-management skills (29 students, about 83 percent). A high portion agreed that their research experience with CEAE improved their professional skills related to communicating with diverse audiences (30

students, about 86 percent), seeking feedback (28 students, about 80 percent), teamwork (27 students, about 77 percent), and overcoming barriers to collaboration with senior colleagues (27 students, about 77 percent) or peers (24 students, about 69 percent). These findings show that, although their tasks were research project-oriented, undergraduate students gained professional skills by working as research assistants under professors and postdocs. They can apply those skills (especially those related to independent working) to their career. Even though research projects involve collaboration and teamwork, most routine tasks are conducted independently. That is likely the reason why respondents gained more skills and abilities working independently than working with their team members.

As introduced above, the CEAE Mentoring Network supports CEAE’s mission to cultivate an inclusive academic community of applied economics researchers through a “layered mentoring” format. In the survey, we asked whether respondents received and/or provided mentoring. Twenty-six students (about 74 percent) received mentoring, 9 students (about 26 percent) provided mentoring, and 8 students (about 23 percent) were not involved in mentoring. Eight students (about 23 percent) both received mentoring and provided it. Compared to postdoctoral researchers and graduate students in the mentorship network, undergraduate research assistants are juniors and therefore mostly received mentorship from other members in their mentorship groups. Since the “layered mentoring” format also includes peer-to-peer mentorship, we see that a small portion of respondents also provided mentoring.

CEAE leadership invests in initiatives to increase diversity within the CEAE community, including recruiting diverse members (e.g., undergraduate research assistants, graduate students, postdoctoral researchers, and research participants); supporting a layered mentorship program; investigating research questions related to diversity, inclusion, and equity (e.g., environmental justice); and collaborating and building partnerships with diverse communities and institutions. To understand undergraduates’ perceptions of the effectiveness of these efforts, we asked respondents to indicate which of these actions have contributed to improving diversity in the field of applied economics (Table 1). Respondents indicated that CEAE has contributed to improving diversity mainly through recruiting, especially recruiting undergraduate research assistants and graduate students. Recruiting postdoctoral

Table 1: Avenues for Promoting Diversity in CEAE and Applied Economics.

In what ways has CEAE contributed to improving diversity in applied economics?	Number of Selections
Recruiting Undergraduate Research Assistants	30 (~86%)
Recruiting Graduate Students	25 (~71%)
Recruiting Postdoctoral Researchers	18 (~51%)
Collaborating and Building Partnerships with Diverse Communities and Institutions	16 (~46%)
Recruiting Research Participants	15 (~43%)
Investigating Research Questions Related to Diversity, Inclusion, and Equity (e.g., Environmental Justice)	14 (40%)
Layered Mentorship Program	8 (~23%)
CEAE Has Not Contributed to Improving the Diversity of the Field of Applied Economics	2 (~6%)
I Am Not Sure	3 (~9%)

researchers and research participants, as well as collaborating and building partnerships with diverse communities and institutions are other approaches that respondents felt CEAE was taking to promote diversity in applied economics. Seven respondents (20 percent) indicated that they were “unsure” if CEAE supported diversity, indicating that there may be value in more clearly communicating with undergraduates about why it is important to promote diversity in our field and what efforts CEAE takes to contribute to this effort. Three of the seven respondents (about 43 percent) who selected “unsure” worked in CEAE for only one semester. For comparison, of the 28 respondents who indicated CEAE supported diversity, only four (about 14 percent) worked for one semester in CEAE. This result suggests that differences in awareness may be related to how long the student engaged with CEAE.

We further asked whether respondents felt that CEAE leadership (directors, staff, and postdocs) was both supportive of people from diverse backgrounds and appreciative of the diverse perspectives contributed by respondents. The majority of respondents (28 students, 80 percent) felt that CEAE leadership was supportive of people of diverse backgrounds. Respondents were also asked whether they felt their diverse perspectives were appreciated. About a quarter of respondents (9 students, about 26 percent) selected “unsure,” which we expect may indicate that either they did not believe the question applied to them or could not recall.⁴ Of the 26 respondents who definitively answered the question, 25 selected “yes” and one selected “no.”

We also sought to understand whether and how the benefits that undergraduate research assistants gained from working with CEAE carried over to their next stages in their professional life after their graduation. For this analysis, we considered responses from the 34 survey participants who no longer attend an undergraduate program. Thirty-one out of 34 respondents (about 91 percent) have had a job placement after their undergraduate program, and they currently have a job placement today. Among these 31 respondents, fifteen (about 48 percent) pursued graduate studies (master’s or PhD) immediately after their undergraduate programs, and another third took jobs in the private sector (12 students, about 39 percent of all respondents). Among the 23 respondents who have a current job placement that does not include graduate study, positions cover a wide range of sectors from the private sector (12 respondents) to the public (10 respondents) and nonprofit sectors (1 respondent). Their placements represent the general job placements of students in UD’s College of Agriculture and Natural Resources.⁵

Although many factors contribute, we asked whether working with CEAE affected respondents’ life path decisions after graduating. Most respondents found that their experience with CEAE: (1) increased their interest in pursuing a career in applied economics and (2) helped clarify both the field they wanted to study and if graduate school was a good choice for them. Specifically, we asked for the respondents’ likelihood of pursuing the education and career options before and after working with CEAE. CEAE experience made undergraduate research assistants more interested in further exploring applied economics, on average (Figure 6). This effect was greatest with those originally with a low likelihood of pursuing education and career options in applied economics. In particular, 13 out of 23 (about 57 percent) respondents who were originally unlikely to pursue graduate education in applied economics changed to somewhat likely or very likely after working with CEAE. Twelve out of 22 (about 55 percent) respondents who were originally unlikely to pursue graduate education in applied

⁴ One such respondent stated at the end of the survey, “I enjoyed my work with CEAE, but it was a long time ago so I don’t have the best memory when it comes to management and leadership.”

⁵ We planned to compare placements of CEAE students to placements for agricultural and applied economics students in general; however, we could not find data about the overall placements of undergraduate students in our field. Over 25 years ago, Zepeda and Marchant (1998) recommended that collecting and communicating placement data could improve enrollment and increase diversity in agricultural economics programs by strengthening recruitment efforts and supporting students’ career preparation and expanding their professional networks. Collecting this data is also imperative if we want to examine how focused educational initiatives (e.g., undergraduate research programs) impact placement outcomes.

economics-related fields changed to somewhat likely or very likely. Six out of 12 (50 percent) respondents who were originally unlikely to pursue a career in applied economics or related fields

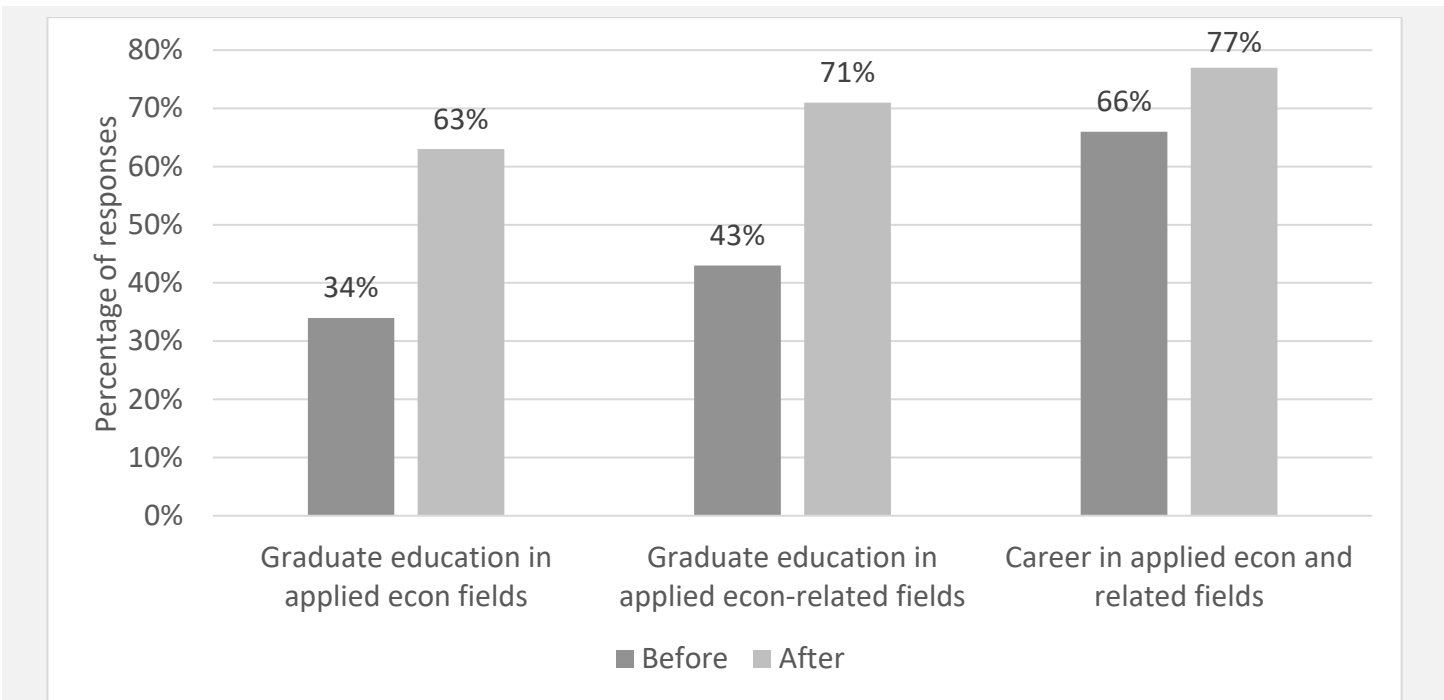


Figure 6: Percentage of Respondents Indicating They Were “Somewhat Likely” or “Very Likely” to Pursue Graduate Education and Careers in Applied Economics Before and After Working with CEAE.

changed to somewhat likely or very likely. All undergraduates who originally felt they were very likely to continue engaging with applied economics felt the same way after their experience.

4.2 Interviews

High levels of satisfaction with undergraduate research experiences in CEAE were reported in the interviews, and these results were consistent with the high level of satisfaction that was reported in the broader survey. Interviewee #1 was a programmer hired through a job listing while attending a local technical community college. The student later transferred to UD and then worked at UD after graduating. Interviewee #2 was a research assistant recruited through the talent pool studying an economics-related field at UD while working with CEAE. They double majored in two economics degrees, completed an undergraduate thesis, and entered the private sector after graduating. Interviewee #3 was a research assistant recruited due to their work as a Teaching Assistant who studied an economics-related field at UD while working with CEAE. They attended graduate school in an economics-related field at UD after graduating. Interviewee #4 was a research assistant recruited through an internship listing who studied a non-economics-related field at a different university than UD while working with CEAE. They entered the workforce after graduating but are likely to attend graduate school (potentially to study an economics-related field) in the future.

One major theme that emerged was the value of hands-on exposure to applied economics and research. The experience of actively doing the work seemed to have a large impact on the way students understood and felt about applied economics. Interviewee #3 shared that, *“doing the hands-on work... [was how I] got really interested in applied economics, because I was actually teaching it rather than just learning it,”* and interviewee #4 explained that their CEAE experience showed them, *“the field of*

economics was much broader than what I envisioned.” They went on to say their CEAE experience “was really key to me understanding what the research process was like. Really participating in the data collection process gave me a new understanding of what it takes to collect data.”

Even for students with a strong economic background, the additional exposure seemed beneficial. As interviewee #2 (who double majored in two economics degrees) shared, *“When you are in class learning about these things it is all theory, you are not really applying any of it. When you are doing these experiments, you interact with participants in studies and get to realize that the theories can be true. You get to apply it to real life.”* The students seemed to desire such an experience even before their time with CEAE, as all of them listed gaining experience as a reason they chose to work for CEAE.

In addition to experience and pay, all interviewees reported gaining new skills. The skills ranged from economic measurement techniques to programming skills depending on the job they held, but all of them reported being given tasks that required them to learn new skills. Interviewee #4 also spoke at length about the confidence the new skills and experience gave them, saying, *“I came back [to college] confident and reinvigorated. That was something the professor I had been [previously working on research with] thought was really cool, and so she brought me on to do another project because she thought I grew a lot as a researcher. That was definitely an influence from [CEAE]. More broadly, when I was looking for jobs after undergrad, I felt very confident that I wanted to do research and I can very, very specifically say that it was because of [CEAE]. It was not just that I had experience, it was that I had such a positive experience at the Center[CEAE] that I felt like I wanted to keep doing that.”*

Interviewees also appreciated the process CEAE uses to grow students’ professional skills by involving them in multiple aspects of research. Interviewee #2 said *“Starting off I think you are given more simple tasks and, if you are able to handle it, [you are given more tasks]. For me, back when I first started in the talent pool, it was mostly data collection stuff and then we progressed...[later]. I was able to do more planning of the experiment and data collection. Going into senior year I started doing more data analysis.”* Interviewees discussed how their tasks forced them to learn or expand their professional skills. Interviewee #1 mentioned that the programming experience and work made them *“better as a programmer just working and doing the stuff that they wanted me to do. I had to do stuff I would never have done before from a programming standpoint.”* Interviewee #4 commented that their time with CEAE *“was really key to me understanding what the research process was like. Really participating in the data collection process gave me a new understanding of what it takes to collect data.”*

All interviewees identified CEAE as influencing their post-undergraduate life path to some degree and the connections that students made at CEAE played a key role in shaping life paths. Interviewee #3 decided to stay at UD for graduate studies to continue working with CEAE-affiliated professors. Interviewee #1 felt the connections they made through working with CEAE helped them obtain their current position. Interviewee #2 cited the professional experiences as being key to getting future positions. Additionally, interviewees #2, #3, and #4 shared that exposure to graduate students, and graduate student work helped clarify if they wanted to go to grad school, at least for applied economics.

All interviewees still use at least some of the skills and perspectives they obtained/honed with CEAE. Interviewees #1 and #3 reported still using general people skills such as being comfortable talking to strangers or being comfortable leading and mentoring. Even interviewee #2 (who now works in an unrelated field) reported that their exposure to applied economics has *“influenced my perspective on current events... learning about incentives has changed my perspective on what goes on in the news.”* Other students more directly apply their experience. Interviewee #3 shared an anecdote, saying, *“I lead a monthly office hours and the topic [the week of this interview] was about behavioral economics. I actually used part of a presentation I made for the Center [CEAE] and presented it as a learning session.”*

CEAE’s outreach/overlap with other programs both at and outside of UD was the reason all interviewees found CEAE at all. Interviewees #2 and #3 found CEAE by taking elective courses taught by CEAE-affiliated professors. Interviewees #1 and #4 found it through job/intern listings at other universities. A bonus of this undergraduate recruitment technique is that a more diverse group of

academic interests is reached than if only students already involved in applied economics were contacted. At least among the interviewees, the main reason they had not engaged with applied economics research before joining CEAE was a lack of exposure. Focused recruitment efforts outside of economics enhance the diversity of students and the perspectives they share, which enriches undergraduate research experiences and supports stronger, more thoughtful research.

5 CEAE Leadership Reflections and Recommendations

Through reflection on our experiences developing and engaging with the CEAE undergraduate research program, we highlight several key advantages and challenges associated with undergraduate research in applied economics. Additionally, we offer ten recommendations for developing effective programs that offer benefits to both students and the lead researchers.

Advantages:

- *Educational Alignment:* Incorporating undergraduates in research roles is more than just practical—it reinforces the educational vision of our institution. Research is an integral component of higher education, and by involving undergraduates, we foster an environment of inquiry and innovation.
- *Beneficial Outcomes for Students:* Multiple studies have illuminated the positive outcomes for undergraduates who immerse themselves in research (Russell, Hancock, and McCullough 2007). Engaging in real-world projects cultivates critical thinking, problem-solving, and teamwork skills. Notably, minority and first-generation students often experience amplified benefits, including bolstered self-confidence and heightened academic achievement.
- *Cost-Effectiveness:* Engaging undergraduates often represents a prudent financial choice. Compared to the costs associated with employing graduate students, postdocs, or staff, undergraduates offer an affordable yet effective alternative for many research tasks.
- *Scalability:* Conducting field experiments, especially in large festival-like settings, often requires assembling a large team of people who can work on these projects. Being able to hire a group of undergraduates to conduct this research can be quite helpful and can extend the reach of graduate students, postdoctoral associates, and faculty.

Challenges:

- *Skill Gap:* Undergraduates, though enthusiastic, often enter our program without advanced skills in experimental design, data analysis, or academic writing. This necessitates dedicated training sessions and close supervision.
- *Training Overhead:* With the regular admission of new undergraduate students into our research team, there is a recurring need for orientation, training, and mentoring. This continual onboarding can be time-consuming and requires dedicated resources to ensure that students are well-equipped for their roles. One of our recommendations is to hire students early in their first two years of undergraduate study so that they can help train future undergraduate students.
- *Turnover Rate:* Given the transient nature of undergraduate education, there is an inherent turnover as students graduate or move onto different opportunities. This necessitates consistent recruitment and transition processes to maintain continuity in research projects.
- *Unrealistic Expectations:* Some students who are inspired by the environmental and socially engaged research that is conducted in CEAE are disappointed to find themselves standing outside on a hot day recruiting study participants or being inside on a computer entering data or reconciling receipts for participant support. While necessary, these tasks are not as exciting as students may have hoped. To help this situation, we have often hired students majoring in accounting to work on the logistical elements as they seem more content with these tasks. We

also have found that students who hold leadership positions in student organizations are particularly good at collecting data and engaging potential participants, as they tend to be extraverted and pay attention to small logistics that can make a good experiment (or party). To capitalize on these advantages and to address these challenges, we have developed the following ten recommendations that again come from our experiences and our approach to creating a synergistic undergraduate research program. Whenever possible, we have highlighted the recommendations that were also directly supported by the data collected from CEAE alumni.

- 1. Do not underestimate the skills of the top undergraduate students.** Top-tier undergraduate students frequently perform on par with, if not exceeding, the capabilities of many graduate students, staff, and even postdocs in a diverse array of tasks. Yet, undergraduate students cost dramatically less, and engaging them in research contributes to their own personal and professional development and strengthens the pipeline for our field. From our survey responses, we saw that respondents were commonly tasked with multiple responsibilities, showing that they were capable of conducting various tasks for research projects, from administrative and accounting duties to experimental design. In addition, interviewee #2's senior thesis contributed to a research paper.
- 2. Develop a volunteer program ("talent pool").** To improve talent identification, offer opportunities for undergraduate students to engage in research on a volunteer basis. This initial phase serves as an evaluative period, allowing both the students and the research team to assess mutual fit. It also allows students who are interested to get involved mid-semester, even when existing funds have been committed to others. Second, use this talent pool for selecting candidates for future funded positions. This method not only streamlines the recruitment process but also ensures a higher likelihood of engagement and productivity from those who transition from volunteer roles to funded positions. Interviewee #2's experience was a successful example of the talent pool. They were initially recruited via the talent pool. With a successful "trial run," they were hired to fulfill more responsibilities and lead more research activities.
- 3. Pay above-market wages.** University campuses are full of extremely talented young people who are often eager to connect to meaningful projects. As students transition from the talent pool to paid positions, we recommend paying at least 20 percent higher than wages available to these students in other settings. Interview #1's initial motivation to work at CEAE was to get a job that pays well for undergraduate students. Among 30 respondents who were paid for their undergraduate work, 28 respondents (about 93 percent) in our survey were extremely satisfied (16 students, about 53 percent) or somewhat satisfied (12 students, 40 percent) with the compensation they received for their work. These indicate that above-market wages not only facilitate the recruitment of top-tier students, but also serve as a retention tool for those already bringing value-added efforts to research projects.
- 4. Recruit students from multiple majors.** Conducting successful experiments requires a diversity of skills, thus we recommend hiring undergraduates from a diverse set of majors (not just economists or students interested in the topical area). This approach enriches the research team, enhances problem-solving capabilities, and ensures that the students are engaged in their specific tasks. For example, interviewee #4 was from a non-economic background and only did qualitative, rhetoric-based research before joining CEAE. They described that their non-economic background helped them better engage people in recruiting participants. They were also able to be creative in applying prior knowledge and skills to economic research. In addition, half of our survey respondents studied an economics-related major and the other half studied non-economics. This not only shows that students from non-economics majors were attracted to our work, but also echoes our experience

that students from multiple majors can bring different perspectives and contribute to different tasks, especially given that our research projects aiming to solve real-world issues are interdisciplinary in essence.

- 5. Hire undergraduate students in their first or second years.** We recommend the recruitment of students during their first or second years of their undergraduate study. The development of research projects takes more than just one semester or year. Because of this, we have found that hiring undergraduate students early on will give them more time to gain different responsibilities, a better understanding of the research process, exposure to more opportunities, and the development of various skills. This early integration allows for time to cultivate their research abilities and, importantly, to establish an internal mentorship system. Through such a system, more experienced undergraduate researchers pass down their accumulated knowledge and skills to their younger counterparts, thereby enhancing both individual and collective research efficacy.
- 6. Hire undergraduate researchers on a semester-by-semester basis.** Hiring on a semester-by-semester basis offers faculty and research staff the flexibility to assess student engagement, seek funding for students, and seamlessly part ways with individuals in a low-conflict manner who are not fully invested in the research endeavors. Importantly, our experience suggests that this approach does not adversely affect the retention of top-performing students, who often feel rewarded for their high productivity. Interviewee #2 was initially hired into the talent pool but was gradually tasked with more responsibilities by semesters, and their research experience eventually helped them with producing a senior thesis.
- 7. Nurture a diverse group of undergraduate researchers.** Foster an inclusive setting where undergraduate students not only feel valued for their contributions but are also encouraged to bring their diverse perspectives to the table. We advocate for proactive measures that both honor these varying viewpoints and provide targeted support for students' career development.
- 8. Develop a layered mentoring program.** To facilitate the holistic development of undergraduate students, we recommend the implementation of a tiered mentorship initiative. This model not only allows students to gain valuable insights from multiple mentors at various career stages, but also fosters an interconnected community of academic growth and support. This model has also shown to be successful in our experience. From the survey, we saw that most respondents (26 students, about 74 percent) received mentoring, and a small portion (9 students, about 26 percent) of respondents provided mentoring. The latter highlights the uniqueness of a layered mentoring program. Interviewee #1 mentioned that they were welcome to reach out to the previous student in the mentorship program. Interviewee #3 specifically said that getting mentored was one of the most valuable experiences they had, and they use the skills they gain mentoring other CEAE undergraduates in their jobs today.
- 9. Leverage external funding to increase internal funding.** Based on our professional experience and leadership approach, we recommend the strategic utilization of external grant awards as a leverage point to obtain internal institutional funding dedicated to undergraduate research endeavors. This approach often enables the externally funded project to achieve more research tasks and ultimately be more successful.

10. Encourage students to present their work. We recommend undergraduate researchers disseminate their work through presentations at academic forums, conferences, and even competitions. Such experiences are invaluable for their professional development and serve to elevate the overall quality of undergraduate research experiences. Encouraging students to present their work also helps students realize their contributions to the field and the impacts of their work, as well as improve their presentation skills. This was observed in the survey responses as most respondents thought that the project(s) they contributed to would advance the field of applied economics (27 students, about 77 percent) and had real-world impacts on practices and policies (29 students, about 83 percent). Additionally, 24 students (about 69 percent) improved their skills in delivering an oral presentation or developing poster presentations. Moreover, interviewee #3 discussed how they still draw from an old CEAE presentation for presentations they give at work.

6 Conclusion

This article describes approaches that we have found effective for synergizing experimental economics research and undergraduate research experiences at CEAE based on lead researchers' experiences working with undergraduate students, as well as survey responses and interviews with previous undergraduate research assistants. Through the survey and interviews, we learned about undergraduate research assistants' experiences engaging in economic experiments at CEAE, how their research experiences influenced their undergraduate education, the next steps in their professional lives, as well as how these experiences developed their research and professional skills. Both survey responses and interviews showed that undergraduate research assistants were satisfied with their experiences with CEAE, and their work was meaningful and impactful. In addition to gaining a better understanding of the research process and improving research skills through multiple responsibilities, undergraduate research assistants also improved their professional abilities and skills that they continue to use in their post-graduation endeavors. Working with CEAE also affected respondents' decisions about their life path and stimulated their interest in pursuing further education opportunities and a career in applied economics.

Based on our experiences, survey responses, and interviews, we highlighted the advantages and challenges of our undergraduate research program and suggested ten recommendations. While our ten recommendations are inspired by our experience in CEAE and working in experimental economics research, we believe that these recommendations can be applied broadly to agricultural and applied economics programs given the similar "hands-on" features in experimental economics and applied economics research. Moreover, these recommendations will attract more undergraduate students to the applied economics field and develop undergraduate students' research skills, which likely will improve the recruitment and quality of graduate students and strengthen the pipeline of diverse researchers in agricultural and applied economics. Tracking this pipeline and student placements is critical to evaluating the success of undergraduate research programs and other student-focused initiatives, and we echo earlier calls for improving how we collect and communicate pipeline and job placement data for agricultural and applied economics on a national scale (Hilsenroth et al. 2022; Zepeda and Marchant 1998).

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